

What is claimed is:

1. A method for forming a film on a semiconductor device in a deposition chamber, comprising:
 - providing O₃ within the deposition chamber;
 - heating the deposition chamber to a temperature higher than 480° C; and
 - depositing an insulator layer on a semiconductor substrate in the deposition chamber using a source gas when the temperature of the deposition chamber is higher than 480° C, wherein the source gas includes an organic precursor and an organometallic dopant.
2. The method of claim 1, wherein providing O₃ within the deposition chamber includes providing a concentration of O₃ in O₂ that is within a range from approximately 2% to approximately 20% by weight.
3. The method of claim 1, wherein providing O₃ within the deposition chamber includes flowing O₂ in a corona discharge tube at a rate of approximately 2000-8000 cubic centimeters per minute such that the O₃ concentration in O₂ is approximately 13% by weight.
4. The method of claim 1, wherein the organic precursor includes tetraethyloxysilicate (TEOS).
5. The method of claim 1, wherein the insulator layer is deposited at pressures within a range between approximately 10 Torr and approximately 760 Torr.
6. The method of claim 1, wherein the organometallic dopant includes triethylphosphate (TEPO).

7. The method of claim 1, wherein the organometallic dopant includes triethylborane (TEB).
8. The method of claim 1, wherein the organometallic dopant includes triethylphosphate (TEPO) and triethylborane (TEB).
9. The method of claim 1, further comprising reflowing the insulator layer.
10. A method for forming a film on a semiconductor device in a deposition chamber, comprising:
 - providing O₃ within the deposition chamber;
 - heating the deposition chamber to a temperature higher than 480° C; and
 - depositing an insulator layer on a semiconductor substrate in the deposition chamber using a source gas when the temperature of the deposition chamber is higher than 480° C, the source gas including tetraethyloxysilicate (TEOS), triethylborane (TEB) and triethylphosphate (TEPO).
11. The method of claim 10, wherein:
 - heating the deposition chamber to a temperature higher than 480° C includes heating the deposition chamber to a temperature higher than 510° C; and
 - depositing an insulator layer includes depositing an insulator layer when the temperature of the deposition chamber is higher than 510° C.
12. The method of claim 10, wherein depositing the insulator layer includes depositing the insulator layer at pressures within a range between approximately 10 Torr and approximately 760 Torr.

13. The method of claim 10, wherein providing O₃ within the deposition chamber includes providing a concentration of O₃ in O₂ that is within a range from approximately 2% to approximately 20% by weight.

14. The method of claim 10, further comprising reflowing the insulator layer.

15. A method for forming a film on a semiconductor device in a deposition chamber, comprising:

providing O₃ within the deposition chamber, including providing a concentration of O₃ in O₂ that is within a range from approximately 2% to approximately 20% by weight;

heating the deposition chamber to a temperature higher than 480° C; and

depositing an insulator layer on a semiconductor substrate positioned in the deposition chamber using a source gas when the temperature of the deposition chamber is higher than 480° C, the source gas including tetraethyloxysilicate (TEOS).

16. The method of claim 15, wherein:

heating the deposition chamber to a temperature higher than 480° C includes heating the deposition chamber to a temperature higher than 510° C; and

depositing an insulator layer includes depositing an insulator layer when the temperature of the deposition chamber is higher than 510° C.

17. The method of claim 15, wherein the source gas includes an organometallic dopant.

18. A method for forming a film on a semiconductor device in a deposition chamber, comprising:

flowing O₂ in a corona discharge tube to provide a concentration of O₃ in O₂ within the deposition chamber that is within a range from approximately 2% to approximately 20% by weight;

heating the deposition chamber to a temperature higher than 510° C;

depositing a borophosphosilicate glass (BPSG) film on a semiconductor substrate positioned in the deposition chamber using a source gas when the temperature of the deposition chamber is higher than 510° C, the source gas including an organic precursor and an organometallic dopant; and

reflowing the BPSG film.

19. The method of claim 18, wherein the organometallic precursor includes tetraethyloxysilicate (TEOS).

20. The method of claim 18, wherein the source gas further includes triethylborane (TEB) and triethylphosphate (TEPO).

21. A method for forming a film on a semiconductor device in a deposition chamber, comprising:

providing O₃ within the deposition chamber;

heating the deposition chamber to a temperature higher than 510° C;

depositing a borophosphosilicate glass (BPSG) film on a semiconductor substrate positioned in the deposition chamber using a source gas when the temperature of the deposition chamber is higher than 510° C, the source gas including tetraethyloxysilicate (TEOS), triethylborane (TEB) and triethylphosphate (TEPO); and

reflowing the BPSG film.

22. The method of claim 21, wherein reflowing the insulator layer includes a batch furnace reflow.

23. The method of claim 21, wherein reflowing the insulator layer includes a rapid thermal process.

24. A semiconductor device, comprising:

a semiconductor substrate having a number of active areas; and

a borophosphosilicate glass (BPSG) film having an interface with the number of active areas, wherein the BPSG film is formed on the semiconductor substrate in a deposition chamber using a process, comprising:

providing O₃ within the deposition chamber;

heating the deposition chamber to a temperature higher than 480° C;

depositing the BPSG film on the semiconductor substrate in the deposition chamber using a source gas when the temperature of the deposition chamber is higher than 480° C, the source gas including includes an organic precursor and an organometallic dopant; and

reflowing the BPSG film.

25. The device of claim 24, wherein, after the BPSG film is reflowed, the BPSG film has different carbon concentrations attributable to carbon migration, wherein a highest concentration of carbon atoms is fewer than 10¹⁸ carbon atoms per cubic centimeter, and the highest concentration of carbon atoms in the BPSG film corresponds to a fixed charge density less than 5x10¹⁰ per square centimeter.

26. A semiconductor device, comprising:

a semiconductor substrate having a number of active areas; and

a borophosphosilicate glass (BPSG) film having an interface with the number of active areas, wherein the BPSG film is formed on the semiconductor substrate in a deposition chamber using a process, comprising:

providing O₃ within the deposition chamber;

heating the deposition chamber to a temperature higher than 480° C;

depositing the BPSG film on the semiconductor substrate in the deposition chamber using a source gas when the temperature of the deposition chamber is higher than 480° C, the source gas including tetraethyloxysilicate (TEOS), triethylborane (TEB) and triethylphosphate (TEPO); and reflowing the BPSG film.

27. The device of claim 26, wherein, after the BPSG film is reflowed, the BPSG film has different carbon concentrations attributable to carbon migration, wherein a highest concentration of carbon atoms is fewer than 10¹⁸ carbon atoms per cubic centimeter.

28. The device of claim 26, wherein, after the BPSG film is reflowed, the highest concentration of carbon atoms in the BPSG film corresponds to a fixed charge density less than 5x10¹⁰ per square centimeter.

29. The device of claim 26, wherein the BPSG film includes between 0.5% and 6% boron by weight.

30. The device of claim 26, wherein the BPSG film includes between 0.5% and 8% phosphorous by weight.

31. The device of claim 26, wherein in the process used to form the BPSG film, heating the deposition chamber to a temperature higher than 480° C include heating the deposition chamber to a temperature higher than 510° C.

32. A semiconductor device, comprising:
a semiconductor substrate having a number of active areas; and
a borophosphosilicate glass (BPSG) film deposited on the semiconductor substrate using an organic precursor, the BPSG film including an organometallic

dopant, the BPSG film having different carbon concentrations attributable to carbon migration during reflow of the BPSG film during formation, wherein a highest concentration of carbon atoms in the BPSG film is fewer than 10^{18} carbon atoms per cubic centimeter.

33. The device of claim 32, wherein the highest concentration of carbon atoms in the BPSG film corresponds to a fixed charge density less than 5×10^{10} per square centimeter.

34. The device of claim 32, wherein the BPSG film includes between 0.5% and 6% boron by weight.

35. The device of claim 32, wherein the BPSG film includes between 0.5% and 8% phosphorous by weight.

36. The device of claim 32, wherein the BPSG film includes between 0.5% and 6% boron by weight and further includes between 0.5% and 8% phosphorous by weight.

37. The device of claim 32, wherein the organometallic dopant includes triethylborane (TEB) and triethylphosphate (TEPO).

38. The device of claim 32, wherein a highest concentration of carbon atoms in the BPSG film is fewer than 10^{17} carbon atoms per cubic centimeter.

39. A semiconductor device, comprising:
a semiconductor substrate having a number of active areas; and
a borophosphosilicate glass (BPSG) film deposited on the semiconductor substrate using tetraethyloxysilicate (TEOS), the BPSG film including triethylborane

(TEB) and triethylphosphate (TEPO), the BPSG film having different carbon concentrations attributable to carbon migration during reflow of the BPSG film during formation, wherein a highest concentration of carbon atoms in the BPSG film is fewer than 1018 carbon atoms per cubic centimeter.

40. The device of claim 39, wherein a highest concentration of carbon atoms in the BPSG film is fewer than 1017 carbon atoms per cubic centimeter.

41. The device of claim 39, wherein the BPSG film includes between 0.5% and 6% boron by weight.

42. The device of claim 39, wherein the BPSG film includes between 0.5% and 8% phosphorous by weight.

43. The device of claim 39, wherein the BPSG film includes between 0.5% and 6% boron by weight and further includes between 0.5% and 8% phosphorous by weight.